# *Learning from defects in the UK housing sector using action research: a case study of a housing association*

Article

Accepted Version

[To cite this article: Hopkin, T., Lu, S., Sexton, M.G. and Rogers, P. (2019), "Learning from defects in the UK housing sector using action research: a case study of a housing association", **Engineering, Construction and Architectural Management,** DOI: 10.1108/ECAM-04-2018-0146]

# Learning from defects in the UK housing sector using action research: a case study of a housing association

**Purpose:** Maximising the benefit of learning from defects is regarded by UK housing associations (HAs) as a key opportunity to meet their challenges of building more homes with reduced government funding and rent incomes. Despite learning from defects being a frequent recommendation to reduce defects in the construction literature, there is scarce empirical evidence into how HAs *actually* learn from defects. This research aims to better understand how HAs learn from past defects and induce change to reduce defects.
**Design/methodology/approach:** Guided by organisational learning (OL) as the theoretical lens, a 21-month action research (AR) project explored one HA's defects management and learning processes.
**Findings:** OL has the potential to reduce defects in new homes but is a secondary task which is reliant on a defects management team analysing defect data to identify priority areas. As such, learning from defects can be reduced due to peaks in workload if data analysis is a manual process. . Furthermore, a dual learning approach plays a significant role for HA's learning consisting of designing out defects (codification) supported by networking (personalisation) to tackle issues of workmanship on site and those defects that cannot be designed out.
**Originality/value:** This study demonstrates OL has the potential to reduce defects in new homes but is a secondary task in HA's practice; and highlights the practical challenges of academia and industry co-production in AR in construction.

**Keywords:** action research, defects, housing associations, organisational learning, new-build housing.

**Article classification:** Research paper

## INTRODUCTION

Rapid growth in the production of new homes in the United Kingdom (UK) is putting build quality under pressure, as evidenced by rising defects volumes and decreased customer satisfaction. For example, the Home Builders Federation's (HBF) annual new home customer satisfaction survey reports that in 2018, 69% of home owners reported over five defects in their new-build house, compared to 59% in 2015 - an increase of 10% over the past four years and the percentage of home occupants satisfied with the quality of their new home dropped 1% (HBF, 2018) Over the same period housing completions increased by 16% (DCLG, 2017). Housing associations (HAs) supply the majority of the UK's affordable housing (KPMG and Shelter, 2014) and contribute around 21% of the total annual supply of new homes (DCLG, 2017). HAs are typically government funded and regulated not-for-profit organisations (NAO, 2005). In recent years HAs have experienced increased financial pressure with a funding reduction from the UK Government (KPMG and Shelter, 2014) and a required social housing rent reduction of 1% each year until 2020 (HM Treasury, 2015). Despite these constraints, HAs remain committed to helping ease the UK's housing shortage by developing new homes to rent and for sale. HAs can use surplus revenue from rental income, service charges, and the sale of homes to maintain existing homes and finance new builds (NAO, 2005). Due to the funding reduction, HAs are reviewing their processes to maximise surplus revenue (Chevin, 2013).

Repairing defects is the largest maintenance expense for most HAs (HouseMark, 2012). Social Housing (2018) report that HAs have had some success in reducing cost by cutting back maintenance costs and expenditure on repairs.

Learning from defects and implementing appropriate process improvement strategies has the potential to lower the costs associated with repairing defects (Love, 2002). The extant literature argues that housebuilders (and HAs) should continuously record and analyse their defects to improve performance (Macarulla *et al.*, 2013). Based on this understanding, housebuilders should develop strategies to reduce defects (Macarulla *et al.*, 2013), and improve the design and construction of future homes (NHBC Foundation, 2011). These strategies and improvements can be made by undertaking research (Baiche *et al.*, 2006), developing and sharing good practice (Davey *et al.*, 2006), and re-examining and modifying working practices (Roy *et al.*, 2005).

Despite the recommendation to learn from defects, there is scarce empirical evidence into how HAs actually learn from defects, and make improvements to meet their current challenges. Furthermore, HAs can obtain new homes through Section 106 (S106) agreements (planning requirements) (Monk *et al.*, 2006) in addition to developing their own ones. It is estimated that 37% of the UK's supply of affordable homes is delivered through S106 agreements (House of Commons, 2016). When housing is obtained through S106 agreements HAs have less input in the design and specification of homes when compared to HA built properties and therefore the build quality and longevity may be reduced (Tower Hamlets, 2015). This research therefore aims to empirically investigate how HAs learn from past defects and induce change to improve their learning in order to reduce targeted defects. In this paper, a defect is taken as 'the breach of any mandatory National House Building Council (NHBC) Requirement by the Builder or anyone employed by or acting for the Builder' (NHBC, 2018). This definition has been adopted because 80% of the UK's new homes need to be built to NHBC standards to receive warranty cover and is a definition widely accepted by the housebuilding industry.

## ORGANISATIONAL LEARNING

There is a diverse range of concepts of organisational learning (OL) in the literature. Wang and Ahmed's (2003) literature review paper on OL, for example, indicate there are six principal concepts and practices, namely, focus on collectivity of individual learning; process or system; culture or metaphor; knowledge management; continuous improvement and incremental innovation; and, creativity and innovation. Our understanding of OL is 'the continuous process of creating, acquiring, and transferring knowledge accompanied by a modification of behaviour to reflect new knowledge and insights' (Neilson, 1997:2). The suitability of OL in construction is often seen as problematic due to the project-based nature of construction. For example, Winch (1998) argues that most construction project problem-solving techniques are adapted using tacit knowledge and are situation-specific, and thus difficult to be codified and applied to future projects. Similarly, Barlow and Jashapara (1998) note that those involved in construction projects are not afforded sufficient opportunity to feed past experience into future projects. Research that has explored OL in construction has found that different types of construction projects develop specific learning approaches that recognize local conditions and idiosyncratic challenges (Knauseder *et al.*, 2007).

Large scale housebuilding is argued to be a specific type of activity which is particularly process driven and is closer to manufacturing than it is to other forms of construction in terms of the types of market, the resource inputs, and the organization of the process (Gann, 1996; Knauseder *et al.*, 2007). A number of OL models have been presented in the construction literature. For example, drawn from literature, Chan *et al.*'s (2005) offer a conceptual model on conceptual challenges of OL from a project perspective. Knauseder *et al.* (2007) move away from offering a conceptual model and take a broader approach to demonstrate evidence of different learning approaches based on quantitative empirical data drawn from 51 construction projects. Three learning approaches for enhancing OL are identified, namely, (1) 'organising for learning' to enable the exchange of experiences to expand individual knowledge bases; (2) 'experimenting' with new materials and working styles; and, (3) 'networking' for sharing experiences between others to bridge boundaries and enhance learning. Berkhout *et al.*'s (2006) OL model has been adopted to guide this research as it aligns closely with the characteristics of housebuilding in the following respects. First, it resonates with the industry's process-oriented characteristics in that the model seeks to explore how learning processes are updated. Second, the model has been tested by Berkhout *et al.* (2006) within a housebuilding environment; specifically to guide interviews from a range of functional departments within HAs and housebuilders. Finally, the model has determined how the housebuilding industry responds to persistent problems (defects) in Berkhout *et al.*'s (2006) research. The OL process is a cycle that consists of five constructs. First, 'new signal' is where new stimuli are entering the organisation. Second, 'signal recognition and interpretation' is where an occurrence is recognised as a novel situation which indicates that existing organisational routines are ineffective. Third, 'experimentation and search' is the process of initiating adaptation of organisational routines. Fourth, 'knowledge articulation and codification' is the process of exposing potential adaptation options to an evaluation process in order to select the most suitable option to the organisation. Upon selection of an appropriate option the modified routines are codified to transmit them throughout the organisation. Finally, 'feedback' from experience is sought to validate whether the change is viable, returning to the beginning of a new cycle through a new stimulus.

# RESEARCH DESIGN AND METHODS

## Research approach

The research aim was to investigate how housing associations (HAs) learn from past defects and introduce changes to improve their learning in order to reduce targeted defects. An action research (AR) approach was considered suitable for satisfying this aim. AR is understood as an approach which "simultaneously assists in practical problem solving and expands scientific knowledge, as well as enhances the competencies of the respective actors. The approach is performed collaboratively in an immediate situation using data feedback in a cyclical process that is aimed to increase understanding of a given social situation. AR is primarily applicable for the understanding of change processes in social systems and undertaken within a mutually acceptable ethical framework" (Hult and Lennung, 1980:247). AR usually "involves not only gaining an understanding of the problem and generating ideas for improvement but also the practical application of these ideas in the real world situation" (Mumford, 2001:12). The definition and concept of AR given in the general literature above is generally consistent with those given in the construction literature. Sexton and Lu (2009), for example, define AR as "a group of phenomenological methodologies concerned with introducing change (or 'action'), and critically understanding that change to produce new knowledge ('research'), within a social setting, with the researcher and the indigenous people of that social setting being active participants in the change process under investigation” (pp. 687-688). Furthermore, a number of authors have advocated the utility of AR for construction management research within a number of contexts, such as understanding how small construction firms create, manage and exploit innovation (Lu and Sexton, 2009); improving access to information to support planning and decision making in a construction owner organisation (Azhar *et al.*, 2010) and improving collaborative working among team members in construction (Connaughton and Weller, 2013). While these approaches have somewhat different goals and orientations, they hold a shared assumption that putting academic ideas into practice in the construction management research would benefit from bridging practical and theoretical interests (Gann, 2001).

The reason for adopting an AR approach is because it promotes organisational change (Robson, 2002) (in this case, introducing new defect assessment tools and learning systems in a HA who wish to improve how they learn from defects); and facilitates the development of techniques to provide know-how to create settings for OL (Susman and Evered, 1978) (thus complimenting the theoretical perspective of this research). A five-phase cyclical process view of AR was adopted in this research: problem/opportunity diagnosis, action planning, action taking, evaluating and specifying learning (Lu and Sexton, 2009; Azhar *et al*., 2010).

**Research design**

A single HA was selected. The HA was identified by the National Housing Federation as it was interested in improving their defects management practices. The HA builds around 1,000 new affordable homes per year in the south of England and has a build stock in the region of 20,000 homes. The HA has a ‘development arm’ responsible for building new homes; and, an ‘asset management arm’ responsible for managing the build stock (including defects). The HA’s interviewees were self-selected due to their direct involvement in the HA’s defects management and learning processes. The unit of analysis (Babbie, 2012) was taken to be ‘the defects management team’ who is located in the ‘asset management arm’. Table 1 outlines the main data collection methods with associated participants and duration during the AR phases. It must be noted that the AR participants were changed in the late stage of the ‘action evaluation’ phase, including a ‘new’ Clerk of Works’ and absence of the ‘new’ Asset Manager. Both qualitative and quantitative data were collected. Qualitative data mainly drew upon semi-structured interviews and focus groups which was thematically analysed. Thematic analysis is a method of identifying, analysing and reporting themes within data (Braun and Clarke, 2006). The limitations are that thematic analysis may fail to identify some of the data containing subtle differences (i.e. nuances) (Guest, 2012). Berkhout *et al.*’s (2006) five constructs of OL model were used as initial coding. In contrast, quantitative data mainly drawn from defect records (i.e. the cost of defects, defects volumes and types of defects occurring) exported from HA’s original and modified defect logs (where HA’s defect data and actions are recorded) were analysed using simple statistical analysis. The results enabled the identification of the biggest areas of defects in the ‘diagnosis’ phase and the co-development of ‘interim dashboard solution’ (a fifth intervention) between the HA and the researcher in the ‘action evaluation’ phase.

### Validation

The research was validated by meeting the criteria of credibility, transferability, dependability and confirmability (Shenton, 2004). First, credibility - a number of techniques were employed to help ensure informant honesty, and reflexivity of the researcher, including adopting established research techniques, drawing interview questions from the literature, triangulation of techniques, triangulation of data, member checks, peer scrutiny, random sampling, tactics. Second, transferability - this research is aware of that the conclusions from a single case study may have limited generalisability. This research adopts the position set out by Stake (2005) in that real world studies are valuable for refining theory and suggesting complexity for future direction.  Furthermore, the researcher has provided an explicit research design to allow other researchers to understand how to use it in other case studies; and, the sampling strategy enabled a representative HA to be selected. Third, dependability - the overall research design has been explicitly articulated and, therefore, can be replicated by future researchers; and, the interview and focus group questions were drawn from the existing literature and the same questions were used for all participants. It must be noted that the AR project was unique to the case study, HA, and concentrated on specific interventions. This part of the research, therefore, is not repeatable. Finally, confirmability - in order to maintain as much objectivity as possible this research identified the research opportunity through a literature review, drew the interview questions from previous recommendations to learn from defects and the adopted OL model, where data was recorded during interviews and focus groups; the researcher member checked the participant accounts and also triangulated those accounts against formal HA documentation where possible.

*Table 1: Main data collection methods used during AR phases*

| Phase | Duration | Main data collection methods | HA's participants |
|---|---|---|---|
| Diagnosis | June 2015 | • Semi-structured interviews guided by the adopted organisational learning model<br>• Organisational documentation | • Quality Manager, development arm<br>• Asset Manager, asset management arm<br>• Administrator, asset management arm<br>• Head Clerk of Works, asset management arm |
| Action Planning | October – November 2015 | • Focus group guided by soft systems methodology<br>• Email communication | • Asset Manager<br>• Administrator<br>• Head Clerk of Works |
| Action Taking | November 2015 – September 2016 | • Telephone / email communication<br>• Follow-up interviews<br>• Organisational documentation | • Asset Manager<br>• Administrator<br>• Head Clerk of Works |
| Action Evaluation | October 2016 – February 2017 | • Telephone communication<br>• Semi-structured interview | • 'New' Head Clerk of Works<br>• Administrator |
| Specifying learning | June 2015 – February 2017 | • Entire research process | • The HA in general, in particular, all of the above participants |

## KEY FINDINGS

This section is structured around the five phases of the AR utilised the five constructs of the adopted OL model (see 'OL' section above) to investigate how one HA learns from past defects and then induce change to improve their learning in order to reduce targeted defects in practice.

## Diagnosis phase

The diagnosis phase aimed to understand the HA's localised defects capture and analysis procedures, and knowledge and practice feedback loops to inform future defect reduction. The HA's defect learning process is described around the five constructs of the adopted OL model below.

*0. New signal:* a new signal is triggered by the home occupant (HO) who reports the defect to the HA's call centre. The defect information is then forwarded to the Administrator (asset management arm) who records it on their standard spreadsheet. After contacting the HO to gain additional information regarding the nature of the defect, the Administrator arranges for a clerk of works (CoW) (asset management arm) to investigate the case. The investigation CoW's findings are detailed within a 'free-text description' field by the Administrator.

*1. Signal recognised as need for change:* a need for change starts with the HA 'manually' analysing the defects records within their spreadsheet. The analysis is used to monitor contractors, and product/building system, performance. Three types of analysis are undertaken on a weekly basis: the cost of defects, defects volumes, and the types of defect occurring. The high volume and high individual cost defects are discussed at bi-monthly interdepartmental meetings between the Asset Manager (AM) (asset management arm) and the Quality Manager (QM) (development arm). When specific defects are perceived to have a high level of importance the QM will seek solutions.

*2. Experimentation and search:* the HA's focus is to 'design out defects'. Two mechanisms are used. First, the QM sends out invitations to individuals within HA's development and asset management arms, and external sources (manufacturers) to request suggestions to resolve the identified problem. Second, the HA review schemes that are performing well in the problem area.

*3. Internal selection, articulation and codification into new routines:* in order for a change to be implemented the HA have a review panel consisting of senior personnel who review the proposals and approve the most appropriate solutions. Guided by HA's 'design out defects' principle, an approved change is incorporated into their employers' requirements (ERs) which are updated annually (ERs are the requirements that the contractor must abide by when constructing homes for the HA, including materials).

*4. Feedback:* when the new edition of HA's ERs have been released (annually) the HA use anecdotal feedback and the continuous review of data to evaluate the effectiveness of the change. Anecdotal feedback is used to identify any significant early concerns in respect of the change while the continuous review of data is used to determine whether the updated ERs have resolved the identified issue.

In addition to the five constructs of the adopted OL model, the study identified that an additional OL construct - networking, was required. The HA advocated 'networking' as an alternative to 'design out defects' via ER updates. Networking was undertaken by the Head Clerk of Works (HCoW) (who predominantly focusses on defects post-completion) feeding back the problem areas to his CoWs (who are responsible for investigating new builds and post-completion defects) as 'areas to watch' on current and future homes. Networking mainly consisted of discussions aimed at raising CoWs' awareness to enable them to identify certain problems during construction.

During the diagnosis phase, the HCoW believed that 'balconies' were HA's biggest area of defects and should be the inspection focus during construction.

### Action planning phase

Three of the HA's key participants (Administrator, HCoW and AM) (Table 1) from the diagnosis phase were keen to improve how they manage and learn from defects and asked the researcher to intervene. The action planning aimed to establish the target for change/intervention.

Through a focus group guided by soft systems methodology (Hopkin *et al*., 2016), the HA's current system and what it is supposed to do was explored. The consensus from the three participants indicate the HA's 'current system' for managing and learning from defects was: *"…owned by the AM, who together with the Administrator and HCoW, captures post-completion defect data from the HOs in order to manage the defects remediation process to a* ***satisfactory completion****, and provides* ***real time information*** *as the basis of the learning process to help identify improvement opportunities for future projects, to satisfy customers, reduce targeted defects and long-term repair costs associated with new homes"*. The 'described system' (including activities required to achieve this system) was then compared to the 'current system' and a mismatch was identified which were: (1) the HA did not record, nor analyse home occupant satisfaction; and, (2) the HA had a requirement for the provision of 'live' (real time) data analysis (which is in stark contrast to their manual analysis of long strings of free-text).

The researcher put four key recommendations (Table 2) forward to the HA's participants through a follow-up email. Recommendations 1, 2 and 4 respond to the live data mismatch while recommendation 3 addressed satisfaction levels.

*Table 2: Action plan for improving HA's defect data capture and analysis practice*

| Recommendations | Actor responsible | Target date | OL construct |
|---|---|---|---|
| R1. Recording extra/different data | Administrator | *As soon as possible* | 0. New signal |
| R2. Undertaking additional data analysis | HCoW/Asset Manager/ Administrator | *As soon as possible* | 1. Signal recognised as need for change |
| R3. Introducing a new customer satisfaction survey for repairs | Asset Manager | April 2016 | 0. New signal<br>1. Signal recognised as need for change |
| R4. Developing a bespoke defects management system with live data reporting dashboard | Asset Manager | October 2016 | 0. New signal<br>1. Signal recognised as need for change |

### Action taking phase

During the action taking phase regular contact was maintained with the HA to assess the changes that had been made compared to the recommendations set out. The 'action taken' are discussed in relation to the four recommendations.

R1: Recording extra/different data: the HA made changes to how they captured and recorded data, including: (a) categorising defects by building area, element, sub-element, and damage; (b) recording the type of property experiencing the defect (flat, detached house); (c) recording the type of construction for the property (brick and block, timber frame); (d) recording the priority of the repair (urgent, routine); and, (e) recording whether a complaint has been made during the repair.

R2: Undertaking additional data analysis: the HA made changes to their data analysis, by analysing the following: (a) the frequency of defects by category to identify trends and problem areas (previously this was a manual review of free-text descriptions); (b) the cost by category to identify trends and high cost areas; (c) the frequency and cost by 'construction type' to monitor system performance; (d) the frequency and cost by 'property type' to monitor dwelling type performance; (e) the number of complaints by category to gauge what defects cause home occupants most distress; and, (f) the repair priority by category to outline which defects may cause danger to HOs.

R3: Introducing a new customer satisfaction survey for repairs: this recommendation was not adopted by the HA during this phase due to workload, but was planned for later in the year.

R4: Developing a bespoke defects management system with live data reporting dashboard: this recommendation was not progressed during this phase due to limited IT resource. The HA's AM was disappointed by a lack of progress when explaining that: *"Unfortunately due to limited IT capacity, we have to bid for resource and there are more important projects to our IT team"*. However, the HA still acknowledged the need for 'quick data analysis'. Workload pressures making data analysis in the current format too difficult and time consuming was revealed by the HCoW, noting that *"…with a recent increase in our workload we are getting limited opportunity to analyse data …"* which was disrupting the HA's learning. The AM reiterated the need for quick analysis to enable the HA to continue learning by stating that *"…data analysis in a spreadsheet is laborious, and doesn't provide us with the up-to-date real time information we require…"*.

Due to the lack of progress with the bespoke with a live dashboard and the stress increased workload was putting on the HA's learning, the HA and the researcher co-developed a fifth intervention (AI5) to provide the HA with the 'live dashboard' in their current spreadsheet environment. This was achieved by setting up tables and graphs in the spreadsheet that drew off of the HA's defects log. This solution meant that when additional data were added to the log, the tables and graphs refreshed to provide the HA with a 'live' reporting dashboard, analysing the cost, frequency and customer focus aspects described above.

In summary, during the action taking phase the HA had implemented R1 and R2 to update their data capture and analysis in line with the action plan (Table 2) while R3 and R4 were not implemented due to limited IT resources and high workload. However, with R1 and R2 being implemented the researcher and HA were able to co-develop an 'interim dashboard solution' (AI5) to provide the HA with a live view of their defects performance within their spreadsheet environment. After the actions had been taken, the researcher left the HA for six months to allow the changes to embed.

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## Action evaluation

The action evaluation phase aimed to evaluate the effectiveness of the changes made; and, establish whether the HA had implemented R3 and R4 (Table 2). There are two evaluation points which are discussed below.

*Evaluation point 1:* in early October 2016 during follow-up telephone conversations, the HA indicated that AI5 ‘interim dashboard’ was helping them to identify improvement opportunities. Both the HA’s AM and HCoW remarked that having an up-to-date view of their defects performance (statistical analysis) allowed them to guide their organisation on where to focus. An example of the interim dashboard (AI5) helping the HA to identify improvements came in relation to the HCoW’s belief that balconies were their largest defect and should be the primary area of focus during construction (see the diagnosis phase). The dashboard (incorporating the HA’s historic data) showed that balconies were responsible for less than 5% of the defects by frequency and were the second highest potential cost at circa £50,000. The analysis provided by AI5 helped the HA identify that their largest area of cost and frequency was roofs at around £70,000 and 30% respectively. During the roof investigations it was found that around 60% of the roof issues were in relation to the incorrect installation of soffit ventilation: the roof was not being effectively ventilated, resulting in mould on the walls and ceiling (Figure 1).

During a telephone conversation with the Administrator in late October 2016 it became clear that the HA were focussing on reducing these roof defects in future properties because of their high frequency, high cost, and the health and safety concerns (mould growth) they posed. The Administrator explained that: *“…we now know that we have an issue of incorrect installation of soffit ventilation on a [developer’s name] house type. [HCoW’s name] is working with his team to make them aware of this issue, so they can look out it when inspecting plots of this house type to reduce the issue. We have also made [developer’s name] aware of the problem…”.*

*(a) Batten has trapped felt and rafter tray has been compressed against the felt by the insulation*

*(b) The air path blocked off, resulting in mould growth*

*Figure 1: An example of roof defect issue*

*Evaluation point 2:* a follow-up interview took place in February 2017 between the researcher, Administrator, and a ‘new’ HCoW (the previous HCoW had left the organisation). The HA’s former AM did not attend as he had been promoted to a director role within the organisation. Furthermore, the HA’s new AM did not attend as he failed to see the benefit of learning from past defects.

It was found that the HA had aborted plans to develop their bespoke defects management system (R4*)* and no longer used the interim dashboard solution (AI5); instead, they have purchased a new off-the-shelf package system that their new AM used at his previous organisation. The Administrator explained that the defects were recorded as free-text because categorising them was not possible. The customer satisfaction survey for the HA’s repair service (R3) was not progressing either. The need for extra resources to undertake the survey was emphasised by the Administrator, noting that she *“…would like an extra 20 hours in the week to be able to survey satisfaction, but that’s not likely to happen…”*.

Moving on to the changes that were made during the action taking phase (R1 and R2), the new HCoW explained that these changes were no longer in effect, describing that *“I looked at what we were doing as a department and decided that we don’t want to be doing it [looking at past defects]. My time is better spent training my CoWs and getting out on site to inspect. We have tightened up our inspection procedures to let fewer defects through to completion”.* However, when the researcher asked the new HCoW whether there were any learning opportunities from post-completion defects following the introduction of the HA’s more rigorous inspection processes, the new HCoW needed to check with the Administrator who responded with *“... I wouldn’t know without looking through the repairs...”.*

In summary, although there were earlier indications that the HA were benefitting from the introduced changes, the actions taken had been aborted due to changes in key personnel in the defect management team.

### Specifying learning

Early indications suggested that the HA were learning from this AR project. This learning was evident from the HA making a number of additional changes to how they analysed their data during the action taking phase and working with the action researcher to co-develop a live defects data analysis dashboard. However, at the end of the AR process, one could argue that specifying learning did not happen in the HA due to changes to key personnel. In essence, the HA are in a worse place than at the start of this project whereby they record defect data, but do not analyse it. Without analysing the defect data, the HA cannot identify improvement opportunities.

Further the model that has been developed is based upon what was observed in the HA and the aborted changes added credence to the model by showing that stopping using the model reduced the HA’s learning capability.

## DISCUSSION

### Organisational learning (OL) from defects model in house building

The AR process  enabled the development of a specific organisational learning (OL) from defects model in house building (Figure 2), which consists of two approaches to learning: codification (the primary approach - inner circle) and personalisation (the secondary approach - external circle). The modified model is made up of seven stages. The codification approach (the primary approach) to learning typically follows stages 0, 1, 2, 3, and 4 and the personalisation approach (the secondary approach) follows stages 0, 1, 5, 6, and 4. These stages are discussed below.

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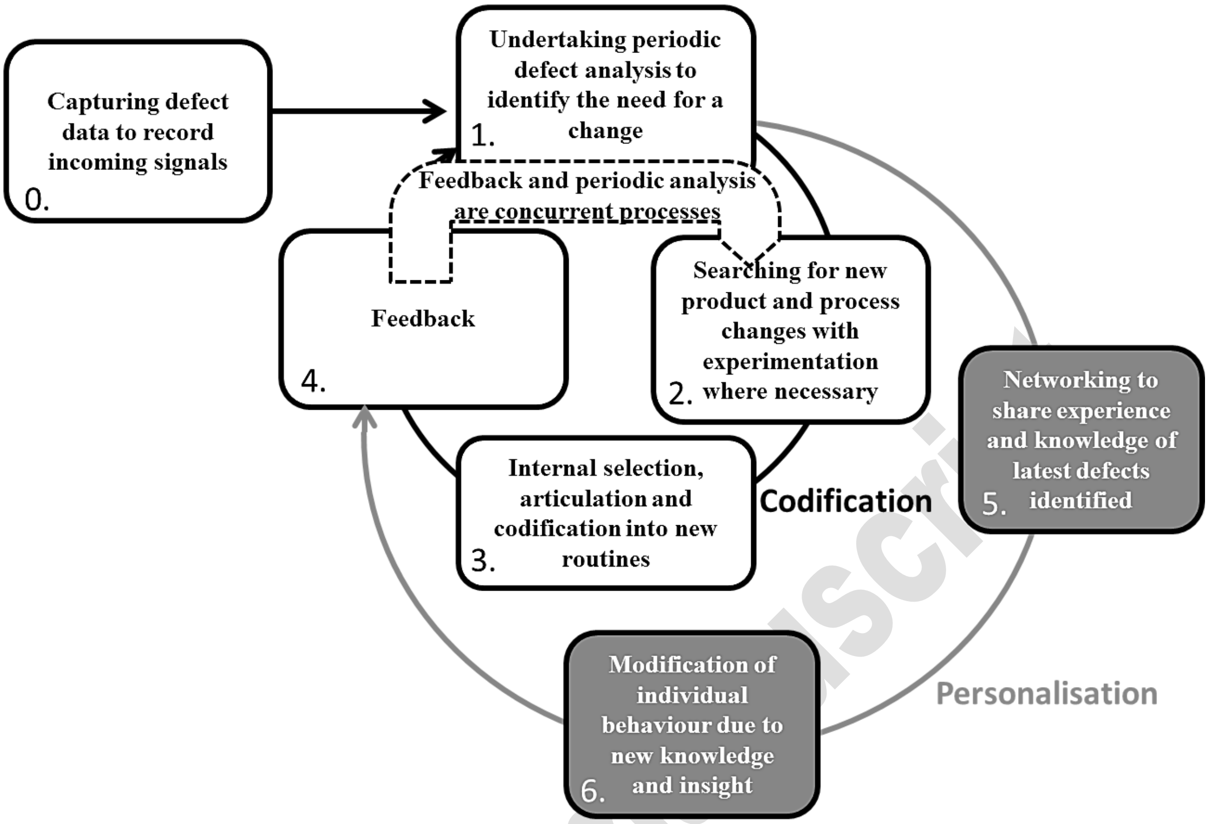


*Figure 2: Specific OL from defects model in housing building*

*0. Capturing defect data to record incoming signals:*

All signals the HA received were external. The external nature of the signals was evident during all AR phases where all signals of defects were reported by the home occupants post-completion through the HA’s defects management system. The implemented R1 (Recording extra/different data) was to change the way the defect data was recorded by the HA’s defect management team in their ‘spreadsheet’ environment – from an unstructured approach (using ‘long strings of free text’ - see the ‘diagnosis’ phase) to a structured approach (using categories for the area of the building the defect occurred, the element affected; and, the damage exhibited - see the ‘action planning to evaluation’ phases). ‘The structured data capture’ was found to enhance the HA’s signal recognition (see the discussion below).

*1. Undertaking periodic analysis to identify the need for a change:*
Recognising signals appeared to be a reactive process in the HA of analysing past defects problems. The periodic analysis identified three important aspects.

(a) The importance of defect data analysis as a process of identifying ‘new signals’ was highlighted. In the diagnosis phase, where the HA was looking to learn from defects they would look at past performance by manually analysing long strings of text (describing defects) periodically as a means of identifying improvement opportunities to determine their future areas of focus. Actions were taken to structure the HA’s data analysis which was shown to remove subjectivity and streamline the HA’s problem identification (see the ‘action taking to evaluation’ phases). The reverting back to record post-completion defect data using ‘free-text alone’ in an ‘off-the-shelf defects management system’ (the action evaluation phase) has resulted in the

HA being unable to identify an improvement opportunities. The categorisation finding echoes Taggart *et al.'s* (2013) assertion that unstructured and informal recording of defects makes it difficult to avoid defects in future homes.

(b) Key individuals were found to play a vital role in introducing and implementing changes. During the diagnosis phase, the HA was reliant on their defects management team analysing defect data to translate past issues into improvement opportunities and thus completed defect learning loop. Similarly, in the action evaluation phase, the AM was the key person who saw HA’s repair costs increasing due to the increasing volumes of defects within their properties and was seeking to improve how they learn from defects to reduce their long-term repair costs. Without these key individuals in championing the changes it would appear that HAs would not learn from defects. This finding is evident in the latter stage of the action evaluation phase where changes were abandoned due to the change in key personnel.

(c) High workload pressure was found to be an obstacle to  learning taking place. It was found that during periods of high workload HA’s learning could be reduced or even stop due to a lack of time available for the defects management team to manually analyse the data and identify those improvement opportunities during the action taking phase. The implemented AIs (undertaking additional data analysis; and, developing a live data reporting dashboard in the HA’s spreadsheet environment) were to enable the HA to quickly undertake defect data analysis, and by doing so, signal recognition was no longer workload dependent. It was found that because the HA categorised defects which enable them to present ‘live’ data, their defect analysis was enhanced and their learning was reported to be improved, suggesting that structured data capture enhanced their signal recognition. In contrast, when the HA no longer analyse defect data, they are unable to identify what is wrong in their properties during the action evaluation phase. The HA now undertake the most basic of single loop learning “detecting and correcting error” (Argyris, 1977).

After the periodic analysis process the HA had two potential streams of action resulting from the identified need for change. These two streams are in the form of procedural changes (codification - the primary approach: stages 2 and 3), and knowledge sharing (personalisation - the secondary approach: stages 5 and 6).

*2. Experimentation and search for new options:*
The HA mainly sourced knowledge from relevant internal people and sometimes known external contractors or manufacturers who were invited to provide solutions to the problem based upon their levels of knowledge and experience in the given area. The finding of the HA continued to source knowledge from known sources is consistent with the key findings from the action planning, taking and evaluation phases. During the action planning phase, the HA sought to use the knowledge and experience from the researcher to improve their learning from defects. During the action taking and evaluation phases, the HA continued to invite solutions from relevant internal people and known external contractors or manufacturers to provide solutions to problems. This process of openly inviting proposals for adaptation options from internal staff is similar to Berkhout *et al.* (2006) who found that the knowledge and know-how to solve problems was held by the specialised communities at work in organisations. The process of openly inviting proposals, however, is the opposite of Lee and Egbu’s (2007) argument that people working in construction are reluctant to talk with their own managers or someone from their own company because they are not empowered to try new ideas and learn due to the rigid management processes.

*3. Internal selection, articulation and codification into new routines:*
When an appropriate product and building system solution had been identified, it was reviewed and approved by a review panel and codified into the HA's organisational routine through updates to the HA's ERs. The process for implementing other changes (such as IT system changes) did not follow the same logic of needing a review panel and was reliant on the individual department for accepting the change. 'Developing a bespoke defects management system and live data reporting dashboard' was identified by the AM as the most suitable option for improving HA's learning. The AM articulated his desire to develop and implement this change to the HA's IT department. However, due to limited IT capacity, various departments and members of the HA had to bid for IT resource, and the defects management system was not considered a higher priority by the IT department. Therefore the change failed to be codified into organisational routine. The failure to codify changes into organisational routine occurred due to the reliance on an individual person, or department to complete the process and may have indicated a lack of consensus building strategy to secure employees' and managers' commitment to ensure that the change is successful (Cornelissen, 2008).

*4. Feedback:*
The finding of HA used 'anecdotal feedback' to gauge the early success of changes, followed by the continuous review of data to determine the success of implemented changes is evident during the diagnosis, action planning, taking and evaluation phases. The anecdotal feedback received in October 2016 showed that the change was having a positive effect on the HA's learning: the HA's AM and HCoW reported that their data capture and analysis changes; and, the introduction of the data dashboard were beneficial to the HA. There is no evidence of negative feedback being given by the HA. Whilst there were indications at the action evaluation point one that the changes made had provided the HA with a more rigorous way of identifying defect improvement opportunities, due to the key personnel changes in the HA this research was unable to fully verify whether the changes had helped them to reduce defects. This suggests that the HA may not use the same feedback mechanisms for changes outside of defects.

*5. Networking to share experience and knowledge of latest defects identified:*
Networking was informal internal communication aimed at raising an individual's knowledge to add to the knowledgebase of the organisation. Networking was typically used to tackle site issues by making HA's CoWs aware of potential problem areas on site. Networking was shown to be successful in tackling site issues such as the roof ventilation defects on a particular builder's house type (Figure 1).

*6. Modification of individual behaviour due to new knowledge and insight:*
In order for networking to be successful the individual needs to modify their working practice based upon the understanding gained from stage 5.

The use of a personalisation (secondary) approach (stages 5 and 6) supports Hansen *et al.*'s (1999) recommendation that organisations should adopt one primary learning approach (in the case of the HAs a codification approach) and then use another approach in a supporting role (in the case of the HAs a personalisation approach).

## AR approach as a suitable approach for organisational learning research

Although the research recommendations were 'temporary' adopted and demonstrated some success in the early stage of this AR project (by helping the HA to refocus their inspection focus during construction from 'balconies' to 'roof' defects), these changes had been abandoned due to changes in key personnel in the defect management team. Whether the action proved successful or not, in the opinion of Argyris and Schön (1996), the AR cycle can continue where the organisation learns more about its nature and environment while the researcher validate or further re-define or re-develop the theoretical framework used. Therefore, the failure in this AR project could be seen that a new problem was there to be diagnosed and that AR was continuing on to the diagnosis phase.

# CONCLUSION

Learning from defects is a frequent recommendation to reduce defects in the literature. There is, however, limited empirical evidence on how HAs *actually* learn from defects in practice. This action research (AR) project contributes to our understanding of this phenomenon through a single case study of a housing association (HA), with organisational learning (OL) as the theoretical lens.

### Contribution to action research approach

The utilisation of an AR approach supports Robson's (2002) suggestion that AR can promote organisational change. For instance, the finding that unplanned actions were developed and implemented by the HA independently of the researcher corroborates Susman and Evered's (1978) argument that AR facilitates the development of techniques to provide know-how to create settings for organisational learning.

### Empirical contributions

The research findings provide three key empirical contributions. First, OL has the potential to reduce defects in HAs but appeared to be a secondary task for HAs. It was found that HA's learning from defects was reduced when workload pressures increased. This demonstrates that the foundation of the HA's OL (improvement identification) was driven by the HA's defects management team and was viewed as a secondary task in times of high workload - defect rectification took priority. This contribution may explain why OL in the more project-based environment of the wider construction sector is more difficult to implement (Winch, 1998). For example, in more project-based construction when the project is completed workers move on to new projects (i.e. a new job, new day-to-day activities, a new priority). This contribution also supports the argument of Barlow and Jashapara (1998) that that those involved in construction projects are not afforded sufficient opportunity to feed experience they have gained from previous projects into future ones.

Second, the importance of live data analysis to identify improvement/learning opportunities was emphasised. The HA was reliant on analysing defect data to identify improvement/learning opportunities. When the HA were able to quickly analyse defects data in order to identify learning opportunities following changes implemented, their OL was reported to improve. In addition, with live data, the HA's learning was less prone to suffering in periods of high workload. The reliance on data analysis was further evidenced by the HA's inability to identify improvement opportunities when they stopped analysing defects data. This contribution also suggests that quick data analysis can enhance a HA's learning; and, also supports Barlow and Jashapara's (1998) suggestion that unstructured and informal feedback systems are often ineffective. Further, it appears that when HAs simply record defect data but do analyse that they are restricted to a very basic form of 'single loop learning' (Argyris, 1977) whereby they simply detect the error (the defect identified) and then they correct the error (repair the defect) without seeking to avoid the defects recurring in future homes.

Finally, the significance of using a dual approach to defect learning was identified. The HA used a primary codification approach to design out defects while used a secondary personalisation approach of networking to reduce defects in a supporting role to tackle site workmanship issues. The use of personalisation approach is especially important given that HAs will receive homes through Section 106 agreements where they have little or no input into the design. The contribution that the HA used a codification approach to learning as their primary approach and a personalisation approach to learning as a secondary approach to resolve issues that cannot be resolved via the primary approach supports Knauseder *et al.*'s (2007) finding that housing organisations adopt one *main* learning approach as well as Hansen *et al.*'s (1999) argument that organisations should adopt one primary learning approach and then use another approach in a supporting role.

## Contribution to OL theory

There are two main theoretical contributions. First, OL has previously been used to explore learning in the construction sector (e.g. Barlow and Jashapara, 1998; Scott and Harris, 1998) and more importantly how housing organisations (i.e. house builders or HAs) generally learn (e.g. Knauseder et al., 2007; Berkhout et al., 2006). However, despite this consistent recommendation to learn from defects, OL does not appear to have been used to explore how house builders or HAs in the UK learn from defects. This research adapted OL to a new empirical setting of learning from defects in a HA environment. Second, in using OL in the new empirical setting the research found a number of contributions that both supported and contested the existing body of knowledge on OL. Based upon the findings from this research the author was able to modify the existing OL model to develop a situation specific OL process for HAs to learn from defects (see Figure 2). This OL from defects model maintained the general premise of the adopted OL model from Berkhout et al. (2006) however some modifications to the existing model were necessary.

## Implications for practice

As the findings highlight the importance of a dual learning approach for HA's learning (codification supported by personalisation). The implication for practice is that HAs need to implement suitable learning systems to reduce defects in new homes. The HAs could capture and analyse defect data to identify defect improvement opportunities and feedback using live data where possible. Following improvement identification, HAs could take a primary approach (codification) of designing out defects (where possible) with the options assessed and approved by an impartial review panel, whilst utilising a secondary approach of networking (personalisation) for site workmanship issues, homes procured through Section 106 agreements; and, as a support whilst the design changes are going through the implementation process. Furthermore, given home occupants' satisfaction with quality of their homes has continued to fail (HBF, 2018), reducing defects may lead to improve their satisfaction.

## Implications for policy

As this research suggests that successful OL can reduce housing defects, but at the same time OL from defects is seen as a low priority for the HA. The implication for policy is to introduce a requirement for HAs who are seeking government funding to demonstrate that they have learning from defects practice in place as part of their funding bid, similar to the current requirements for value for money (HCA, 2017).

## ACKNOWLEDGEMENTS

The authors thank National House Building Council and the Engineering and Physical Sciences Research Council (grant: EP/G037787/1) for their funding and support.

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